Analyzing factors influencing food price dynamics in Turkey: a Bayesian perspective

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Abstract

This study investigates the factors influencing food inflation in Turkey, employing both endogenous and exogenous models and integrating major literature findings. Utilizing monthly data from February 2007 to November 2023, standardized for analysis, it explores the relationship between food inflation and various determinants through classical and Bayesian methods. The analysis reveals that increases in the real effective exchange rate, money supply (M1), Turkish and Federal Reserve interest rates, and the food and beverage price index contribute to rising food inflation. Conversely, higher oil prices have a statistically significant negative effect on food inflation. The most influential variables, determined by their inclusion probabilities in the model, are the money supply, Federal Reserve interest rate, real effective exchange rate, and Turkish interest rate. These findings underscore their importance in understanding and analyzing changes in Turkey's food inflation.

Keywords: food inflation, money supply, real effective exchange rate, commodity prices, bayesian moving averages

Introduction

With the Covid-19 pandemic, supply and demand-side uncertainty in the general level of prices has increased worldwide, and the problem of high inflation has become an important problem for developed and developing countries. Many factors such as increasing demand, supply chain disruptions and rising energy prices cause the general level of prices to increase. In addition, the Russia-Ukraine war, which started in February 2022, led to an increase in energy and food commodity prices. Ukraine and Russia stand as key global grain suppliers, and the conflict in the region has impeded access to these vital resources, consequently causing fluctuations in commodity prices. Long-term empirical analyses underscore the persistent nature of this trend, suggesting that prolonged

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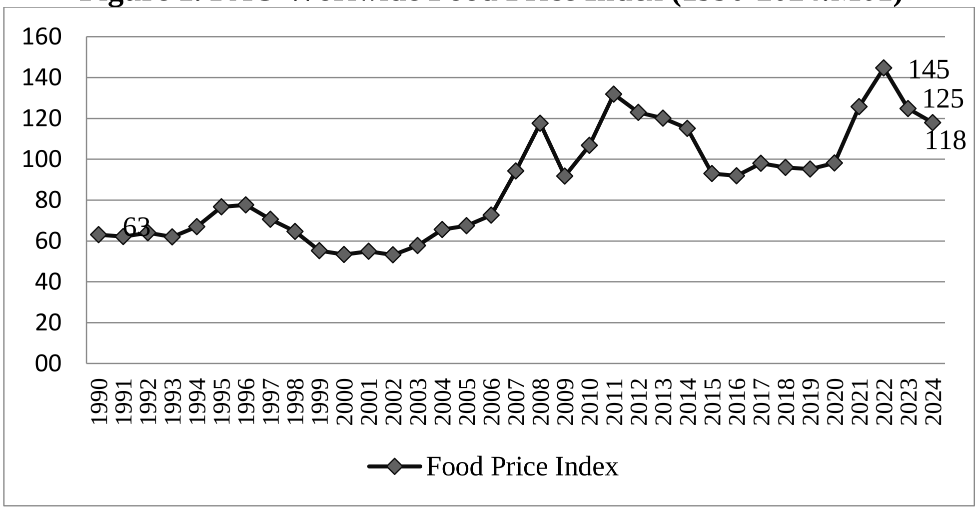
geopolitical tensions will likely sustain the upward trajectory of food prices, particularly within the European context (Sohag *et al*., 2022, pp. 2369). Furthermore, the escalating average temperatures attributed to climate change further compound this issue by diminishing agricultural output, thereby amplifying food prices. Kotz *et al*. (2023) found that global warming will increase food inflation by between 0.92 per cent and 3.23 per cent until 2035. Considering all these factors, one of the factors that significantly affect the general level of prices worldwide is the change in food prices. In Turkey, the price index for food and non-alcoholic beverages, which has an important place among the main expenditure groups of the Consumer Price Index, increased significantly during and after the Covid-19 pandemic, and this rate of increase was 71.01% in 2023. The fact that this rate of increase is higher than the change in the general Consumer Price Indexadversely impacts the accessibility of sufficient food for the economically disadvantaged segments of the population.

FAO, the Food and Agriculture Organization of the United Nations, reported in February that the Food Price Index fell by 1.1% to 118% in January 2024 compared to December 2023 due to the decline in grain and meat prices.

Figure 1. FAO Worlwide Food Price Index (1990-2024:M01)

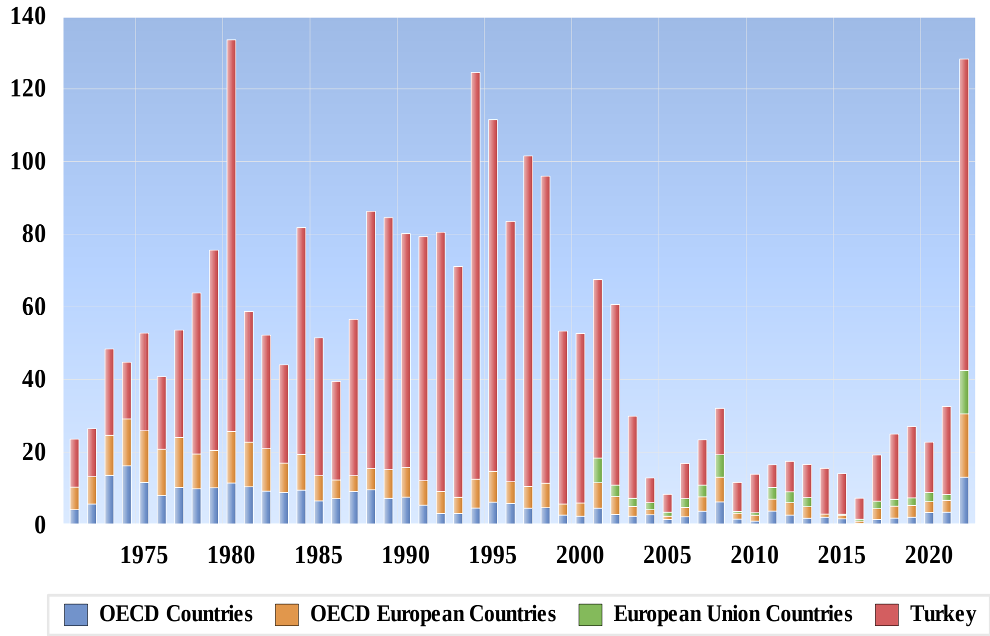


Source: Food and Agriculture Organization of the United Nations (FAO), 2024

As can be seen in Figure 1, the Food Price Index increased by approximately 27.7 points in 2021 compared to 2020 due to supply disruptions due to the Covid-19 pandemic, export restrictions and increased demand, production difficulties due to adverse weather conditions, and exchange rate volatility, and reached its highest level in the last thirty years with approximately 145 index points in 2022. In 2023, the decline in food commodity prices due to the agreement between Ukraine and

Russia on the unblocking of the main Black Sea ports and the increase in grain production in Russia due to favorable weather conditions were reflected in the Food Price Index in 2023 and January 2024.

Figure 2. Food Inflation Rate of OECD, OECD-EU, EU and Türkiye (1971-2022, 2001-2022)



The disparity in Turkey's food inflation rate compared to other country groups is striking. In 2022, Turkey witnessed a substantial increase in food inflation compared to 2020 rates, surpassing the escalation seen in OECD countries by 2.84 times, OECDEU countries by 4.77 times, and European Union countries by 3.76 times (refer to Figure 2). Turkey has the 4th highest nominal food inflation rate in the world after Argentina, Lebanon and Venezuela (FAO, 2024). This trend underscores the urgency of investigating the economic factors driving Turkey's soaring food inflation despite the global downturn in the food price index, particularly evident in the past year. Thorough examination of these factors is imperative to comprehend the unique dynamics at play within Turkey's economy.

There are many factors determining food inflation. When empirical studies are examined, it is seen that factors such as agricultural commodity prices (Baek and Koo, 2010), energy prices (Nazlıoğlu and Soytaş, 2012; Shrestha *et al*., 2019; Taghizadeh-Hesary *et al*., 2019; Gökçe, 2021), money supply and exchange rate (Khan and Gill, 2007, Awan and Imran, 2015; Oral *et al*., 2023), climate change (Odongo *et al*, 2022) and industrial production index (Kutlu, 2021) can explain the change in food inflation. While the source of some of these factors is endogenous, the source of some factors is exogenous. The policy implications for countries in combating inflation vary based on the extent to which exogenous and endogenous factors influence inflation dynamics. When a country's inflation rate is primarily determined by global factors, any instability on a global scale can lead to fluctuations in the country's inflation rate (Kim and Kwark, 2023). In such scenarios, the sensitivity of the general price level to local policies within the country tends to be diminished, resulting in policy implications that may fall short of expectations. Consequently, policymakers in these countries may need to adopt more nuanced and globally oriented strategies to effectively address inflationary pressures and stabilize the economy.

This study aims to address the following questions: What are the country specific and global factors that influence food inflation in Turkey? Among these factors, which ones exert the most significant influence? The determination of endogenous and exogenous factors aligns with the framework proposed by Kim and Kwark (2023). The study considers the following country specific factors: real effective exchange rate, money supply (M1), food and beverage production index, food and beverage capacity utilization rate, and 2-year bond interest rate (TR Interest Rate). Additionally, global factors include the Composite Leading Indicators index, US federal funds rate (FED interest rate), food and beverage commodity price index, OECD industrial production index, and crude oil barrel price. These variables serve as independent variables in the analysis, facilitating a comprehensive examination of the drivers of food inflation in Turkey. With the diversity of variables, it is aimed to analyse global and macroeconomic effects in more detail. The data set[1] created with monthly data for the period 2007:M02-2023:M11 is standardised to have zero mean and unit standard deviation. In the study, the regression relationship between the variables is analysed by the Least Squares method, and then the estimations are repeated with the Bayesian Moving Average Method to ensure that it is robust. Bayesian models are widely acknowledged as a potent tool in statistics and data science, particularly in situations where conventional approaches prove inadequate. Notably, Bayesian methods offer a robust framework for addressing model uncertainty by facilitating the calculation of weighted averages of estimates derived from various model structures, known as posterior probabilities. This allows for informed decisions regarding the relative effectiveness of variables within the model. In the present study, the Markov Chain Monte Carlo (MCMC) sampling method was employed to compute the posterior probability distributions. Specifically, the Bayesian Moving Average method was utilized to address the second question posed by the study, which pertains to identifying the factors exerting the most significant influence within the model setup. By leveraging Bayesian methodologies, the study aims to provide comprehensive insights into the relative importance of different variables in driving food inflation dynamics in Turkey. In the second

[1] Following the standardization of the variables employed in the study, the presence of seasonality is assessed using the TRAMO/SEATS test. The results indicate that there is no seasonality within the variables

part of the study, the literature review on the subject is given and the methodology is explained in the third part. In the fourth section, the results of the analyses are reported. In the conclusion section, the results obtained are evaluated and the study is completed.

1. Literature Review

When reviewing the literature on the subject, it has been observed that the factors significantly influencing food inflation and the directions of their effects vary according to national, temporal, and methodological differences.

Yang, Qiu, Huang, and Rozelle (2008) analyzed the impact of the global food crisis on China's agricultural commodity prices using a Computable General Equilibrium (CGE) model for the period of 2005-2008. According to their findings, it was determined that the shocks causing the global food crisis were largely attributed to increases in oil prices and rising demand for biofuels. In response to the global food price increases, China managed to keep its domestic grain prices below world prices by reducing its stocks and implementing export restrictions on major grains.

Baek and Koo (2010) analyzed the relationship between U.S. food prices and agricultural commodity prices, energy prices, fuel ethanol production, and the real effective exchange rate index using monthly data from January 1989 to January 2008. They employed the Johansen Cointegration method in their analysis. According to their findings, agricultural commodity prices and the exchange rate were identified as two significant factors influencing U.S. food prices in both the long and short terms, while the impact of energy prices decreased in the long term. Studies by Nazlioglu and Soytas (2012) examined the relationship between global agricultural commodity prices, global oil prices, and exchange rates for the period from January 1980 to February 2010 using panel cointegration and panel causality tests. They concluded that oil prices strongly affected agricultural commodity prices. Similarly, Taghizadeh-Hesary, Rasoulinezhad, and Yoshino (2019) analyzed the relationship between food prices and energy prices using a Panel-VAR model for 8 Asian countries during the period of 2000-2016. According to their findings, based on impulse-response functions, agricultural food prices exhibited a positive response to any shock originating from oil prices.

Durevall, Loening, and Birru (2013) examined the dynamics of inflation in Ethiopia using the Ordinary Least Squares (OLS) method. They found that grain and food prices were primarily determined by exchange rates and commodity prices in the long term. While domestic agricultural market supply shocks had an impact on food prices, no direct effect of money supply was identified.

Shrestha, Staab, and Duffield (2019) tested the potential relationship between food prices, biofuel production, and changes in land use through correlation analysis in sub-periods spanning from

1991 to 2016. In their study conducted for three different regions of the United States, among the various variables tested as potential reasons for the increase in the food price index, the variable with the highest correlation is crude oil prices.

When examining studies specific to Turkey, several notable analyses emerge, particularly focusing on the relationship between food and oil prices. For instance, Altıntaş (2016), Utkulu and Ekinci (2016), Gökçe (2021), and İçen *et al*. (2022) investigate the asymmetric relationship between oil prices, exchange rates, and food prices in Turkey over different periods using the non-linear autoregressive distributed lag (NARDL) modeling method. Their analyses reveal that increases in oil prices have a greater impact on food price increases in both the short and long term, and similarly, exchange rates also positively affect food prices. Using a different analytical approach, Gungor and Erer (2022) examined the relationship between food inflation, oil prices, and exchange rates in Turkey with the Time-Varying Parameter VAR (TVP-VAR) method for the period from January 2006 to December 2021. Their findings indicate that increases in exchange rates and oil prices lead to higher food inflation, with these effects being more pronounced during crisis periods.

Estürk and Albayrak (2018) explored the short- and long-term effects of food and agricultural product prices on inflation in Turkey using the ARDL approach. Their research determined that increases in food prices contribute to inflation in both the short and long term. Additionally, they identified a one-way causality relationship between the producer price index of food products, the producer price index of agricultural products, oil prices, and the general consumer price index.

Kutlu (2021) investigated factors influencing changes in food prices in Turkey using the Structural VAR (SVAR) model with monthly data from August 2008 to August 2020. This study included the world food price index, nominal exchange rate, industrial production index, and food product exports as independent variables, while the food and non-alcoholic beverage price index served as the dependent variable. The results indicated that only increases in the exchange rate significantly affected food prices, suggesting that the increases during this period were not demand-driven. Similarly, Orkun Oral, Cakıcı, Yildiz, and Alayoubi (2023) analyzed the factors determining food inflation in Turkey from January 2003 to March 2022 using the Structural VAR (SVAR) method. They found that food inflation significantly responded to shocks in global food prices, oil prices, and money supply, with the exchange rate being the most important determinant during the period studied.

2. Data and methodology

2.1. Data Description

In this study analyses the determinants of food inflation in Turkey with the help of two distinct models, endogenous and exogenous, taking into account the major studies in the literature. The endogenous factors considered in the analysis encompass the real effective exchange rate, money supply (M1), food and beverage production indexes, and food and beverage capacity utilization rate, alongside Türkiye 2-year bond yield (TR Interest Rate). Meanwhile, the exogenous factors include the Composite Leading Indicators index, US federal funds rate (FED interest rate), food and beverage commodity price index, OECD industrial production index, and crude oil barrel price. The data set constructed with monthly data for the period 2007:M02-2023:M11 is standardized to have zero mean and unit standard deviation. The definitions of variables are presented in Table 1.

Table 1. Definitions of variables

Variables	Definition	Source
$\mathbf{INF_{food}}$	Food Inflation Index, (2003=100)	Central Bank of the Repuclic of Turkey https://evds2.tcmb.gov.tr/
RER	CPI Based Real Effective Exchange Rate (2003=100)	Central Bank of the Repuclic of Turkey https://evds2.tcmb.gov.tr
M1	Money Supply (M1)-TL	Central Bank of the Repuclic of Turkey https://evds2.tcmb.gov.tr
$\mathbf{INT_{TR}}$	Türkiye 2-year bond yield	https://tr.investing.com
$\mathbf{P_{oil}}$	Cushing, OK Crude Oil Future Contract 1 (Dollars per Barrel)	https://www.eia.gov/
$\mathbf{CP_{f\&b}}$	Commodity prices/Food and Beverage Price Index, (2016 = 100)	https://www.imf.org/
$\mathbf{PROD_{food}}$	Food production index, (2015=100)	Central Bank of the Repuclic of Turkey https://evds2.tcmb.gov.tr
$\mathbf{PROD_{beverage}}$	Beverage production index, (2015=100)	Central Bank of the Repuclic of Turkey https://evds2.tcmb.gov.tr
$\mathbf{CR_{f\&b}}$	Food and beverage capacity utilization rate,(Percent)	Central Bank of the Repuclic of Turkey https://evds2.tcmb.gov.tr
CLI	Composite Leading Indicators index (Average-12 Month)	Central Bank of the Repuclic of Turkey https://evds2.tcmb.gov.tr
$\mathbf{IPI_{OECD}}$	OECD industrial production index (2015=100)	OECD (2024)
VIX	Chicago Board Options Exchange (CBOE) Volatility Index, monthly. It measures market expectation of near term volatility conveyed by stock index option prices.	https://www.investing.com/
FFR	Federal Funds Effective Rate, Percent, Monthly, Not Seasonally Adjusted	https://fred.stlouisfed.org

Descriptive statistics of the variables indicated in Annex 1. According to the descriptive statistics in Annex 1, the variable INF_{food} fluctuates between a minimum and maximum value of 133.18 and 2552.51 respectively (compared with 2003 as the reference year, corresponding to value 100), with a mean value of 466.17. The variable M1 ranges between a minimum and maximum value of 63 billion and 4631 billion respectively, with a mean value of 712.6 billion. It is observed that, especially after COVID-19, the increasing money supply and inflation values have deviated significantly from their averages. When examining the standard deviations of the variables INT_{TR}, $CR_{f\&b}$, CLI, and FFR, it is observed that these variables have moderate standard deviations, indicating that they are close to the mean value and have a wide distribution. When the mean, standard deviation, minimum, and maximum values of our variables are examined, it is evident that INF_{food}, M1, RER, P_{oil}, $CP_{f\&b}$, $PROD_{food}$, $PROD_{beverage}$, IPI_{OECD} and VIX exhibit very high standard deviations. Consequently, this indicates that these series are highly volatile. After analyzing the correlation results, it was observed that no significant correlations existed between the variables. Therefore, all variables were included in the models (see Annex 2).

2.2. Model Specification

In this study, using the framework established by Kim and Kwark (2023), an analysis is conducted to assess the impact of both country-specific and global factors on food inflation in Turkey, and this analysis is examined and interpreted through the application of three different models. The empirical models to be estimated in this study for Türkiye are as follows:

Model I

$$INF_{food,t} = \alpha_0 + \alpha_1 RER + \alpha_2 M1_t + \alpha_3 INT_{TR,t} + \alpha_{i,t} Z_{i,t} + \epsilon_t \quad (1)$$

Model II

$$INF_{food,t} = \beta_0 + \beta_1 P_{oil,t} + \beta_2 CP_{food\ and\ beverage,t} + \beta_{i,t} X_{i,t} + \varepsilon_t \quad (2)$$

Model III

$$INF_{food,t} = \varphi_0 + \varphi_1 RER_t + \varphi_2 M1_t + \alpha_3 INT_{TR,t} + \varphi_4 P_{oil,t} + \varphi_5 CP_{f\&b,t} + \varphi_{i,t} A_{i,t} + \mu_t \quad (3)$$

The subscript *t* and *i* denotes time period and parameters' number of auxiliary variables. $Z_{i,t}$ refers to the auxiliary variables (food and beverage production indexes, and food and beverage capacity utilization rate) in Model I. $X_{i,t}$ denotes the auxiliary variables (US federal funds rate, OECD industrial production index and Composite Leading Indicators index) in Model 2. Finally, $A_{i,t}$ refers all auxiliary variables as country-specific and global (Model III).

2.3. Methodology

The empirical investigation of this study consists of two parts. Firstly, the stationarity of data is investigated. Following Perron (1989), the innovational outlier (IO) model, in which a gradual break occurs, is assumed for data exhibiting a one-time break. In this study, the preferred specification for the Dickey-Fuller regression in unit root tests is non-trending data with an intercept break. Secondly, the regression relationship between food inflation and the endogenous and exogenous factors in Turkey is analysed using both classical and Bayesian methods. The regression relationship between the variables was initially analyzed using the Least Squares method. Subsequently, to ensure robustness, the estimates were replicated using the Bayesian Moving Average Method. In the Bayesian moving averages method, the Markov Chain Monte Carlo (MCMC) sampling method is preferred for estimating the posterior probability distributions. Using the posterior probability distribution (PIP), the effect strength of the variables on the dependent variable is determined, and the priority of inclusion in the regression model is calculated (Zellner, 1986). According to the criteria established, variables with PIP values ranging from 0.75 to 0.99 are considered to have a strong likelihood of inclusion in the model, while those with values of 0.50 and below are deemed weak candidates for inclusion. Furthermore, it is noted that variables with PIP values approaching 0 tend to have negative coefficients, whereas those approaching 1 are associated with positive coefficients (Magnus *et al*., 2010; Yardımcı, 2019; Boonman, 2023). Through the utilization of Bayesian estimators, it becomes possible to discern which variables exhibit greater efficiency within the econometric model.

3. Empirical Results

Before conducting OLS and Bayesian estimation, a unit root test is investigated on both the dependent and independent variables. Based on the test unit root test results, the variables exhibit non-stationarity in non-trending data when employing an intercept break model at the level (see Annex 3). However, they demonstrate stationarity when examined at their first differences. This suggests that both internal and external shocks affecting these variables in the respective countries are of a permanent nature. Hence, to analyze the relationship between the variables using both Ordinary Least Squares (OLS) and the Bayesian Moving Average (BMA) method, the first difference of variables is evaluated.

The results obtained for Models 1, 2 and 3 respectively are reported in Table 2.

Table 2. The Results of OLS and BMA estimations

	OLS		BMA	
	Coefficient	**t-stat**	**Coefficient**	**t-stat**
MODEL – I				
CONSTANT	0.016 (0.003)***	4.31	0.016 (0.004)***	4.19
RER	0.126 (0.03)***	4.17	0.119 (0.03)***	3.97
M1	0.464 (0.058)***	8.06	0.463 (0.058)***	8.01
INT_{TR}	0.034 (0.012)***	2.90	0.032 (0.012)***	2.73
			Auxiliary Variables	
$PROD_{food}$	-0.025 (0.016)	-1.54	-0.004 (0.011)	-0.37
$PROD_{beverage}$	-0.0002 (0.012)	-0.02	-0.0001 (0.0003)	-0.04
$CR_{f\&b}$	-0.006 (0.004)	-1.48	-0.0009 (0.003)	-0.34
Number of obs	202		202	
MODEL – II				
CONSTANT	0.024 (0.004)***	6.01	0.024 (0.004)***	6.01
P_{oil}	-0.017 (0.017)	-1.03	-0.021 (0.017)	-1.25
$CP_{f\&b}$	0.055 (0.023)**	2.41	0.049 (0.023)**	2.15
			Auxiliary Variables	
CLI	-0.013 (0.01)	-1.31	-0.004 (0.008)	-0.47
VIX	0.005 (0.006)	0.72	0.0002 (0.002)	0.13
IPI_{OECD}	-0.012 (0.021)	-0.57	-0.002 (0.009)	-0.27
FFR	0.167 (0.037)***	4.48	0.155 (0.038)***	4.13
Number of obs	202		202	
MODEL – III				
CONSTANT	0.016 (0.004) ***	4.50	0.016 (0.004)***	4.39
RER	0.104 (0.03)***	3.46	0.099 (0.03)***	3.31
M1	0.41 (0.058)***	7.11	0.412 (0.057)***	7.20
INT_{TR}	0.044 (0.012)***	3.58	0.044 (0.012) ***	3.64
P_{oil}	-0.029 (0.015)*	-1.88	-0.034 (0.015)**	-2.29
$CP_{f\&b}$	0.053 (0.019)***	2.68	0.049 (0.019)***	2.58
			Auxiliary Variables	
$PROD_{food}$	-0.021 (0.016)	-1.30	-0.003 (0.009)	-0.29
$PROD_{beverage}$	-0.005 (0.012)	-0.39	-0.0005 (0.004)	-0.14
$CR_{f\&b}$	-0.006 (0.004)	-1.55	-0.002 (0.004)	-0.44
CLI	-0.008 (0.008)	-0.98	-0.0014 (0.005)	-0.32
IPI_{OECD}	-0.004 (0.019)	-0.21	-0.0013 (0.006)	-0.21
VIX	0.004 (0.006)	0.79	0.0003 (0.002)	0.16
FFR	0.135 (0.033)***	4.06	0.123 (0.035) ***	3.56
Number of obs	202		202	

Note: The values within parentheses in the table indicate the standard errors of the coefficients.*,** and *** denotes 10%, 5% and 1%, respectively. t table values are 1.645, 1.96 and 2.576 for 10%, 5% and 1%, respectively. According to the OLS estimation results, the R^2 values for Model I, Model II, and Model III are 0.315, 0.111, and 0.384, respectively. To elucidate the relative importance of each regressor, we calculate the posterior inclusion probability (PIP) in BMA regression models. According to the results of the BMA regression models, the posterior inclusion probability (PIP) for each of the focus regressors is 1, indicating that these regressors are included in the model with a probability of 1.

In Model 1, it is observed that only the real effective exchange rate, money supply, and interest rate exhibit a positive and statistically significant effect on food inflation. In Model 2, a one unit increase in food and beverage commodity prices in Turkey leads to an approximate 0.05 unit rise in food inflation, while an increase in the FED interest rate results in a 0.15 unit increase in food inflation. Among the auxiliary variables in Model 2, only the FED interest rate emerges as statistically significant. In Model 3, an attempt is made to explain the effects of all variables within a single model. The findings suggest that the real effective exchange rate, money supply, TR interest rate, and food and beverage commodity prices exert a positive influence on food inflation, whereas an increase in oil prices has a negative impact. Moreover, in Model 3, the effect of the FED interest rate remains positive and statistically significant. Furthermore, to compute the posterior probability distributions of the variables in Model 3, the Bayesian Moving Average Method is re-estimated with all variables included as auxiliary variables. The Posterior probability distribution results are represented in Table 3.

Table 3. The Posterior Probability Distribution Results

Variables	PIP	t-statistics
RER	0.92	2.25
M1	1.00	7.08
$\mathbf{INT_{TR}}$	0.87	1.91
$\mathbf{P_{oil}}$	0.21	-0.42
$\mathbf{CP_{food\ and\ beverage}}$	0.32	0.56
$\mathbf{PROD_{food}}$	0.18	-0.38
$\mathbf{PROD_{beverage}}$	0.07	-0.09
$\mathbf{CR_{food\ and\ beverage}}$	0.21	-0.43
CLI	0.12	-0.27
$\mathbf{IPI_{OECD}}$	0.10	-0.20
VIX	0.09	0.18
FFR	0.95	2.54

Upon analyzing the results presented in Table 3, it becomes evident that the money supply, FED interest rate, real effective exchange rate, and TR interest rate variables are the most efficient within the model. These variables exhibit respective values of 1, 0.95, 0.92, and 0.87, signifying their prominence in explaining food inflation dynamics. This suggests that these variables play a crucial role in influencing food inflation in Turkey and should be accorded significant consideration in policy formulation and decision-making processes.

Conclusions

The Covid-19 pandemic, which started in Wuhan, China in 2019 and spread globally, and the Russia-Ukraine war, which started in February 2022, increased the uncertainty in the general level of prices worldwide. While the pandemic pushed prices higher due to increased demand and supply chain disruptions, the war led to an increase in energy and food commodity prices in particular. The fact that Ukraine and Russia are major grain producers around the world ensured that this effect was felt on a global scale. This study analyses the country-specific and global factors determining food inflation in Turkey and investigates the most influential ones among these factors. In this context, in the light of related studies, variables such as real effective exchange rate, money supply (M1), food and beverage production index, food and beverage capacity utilisation rate, 2-year benchmark interest rate (TR Interest Rate) were used as endogenous factors determining food inflation; while the composite leading indicators index, US federal funds rate (FED interest rate), food and beverage commodity price index, CBOE volatility index, OECD industrial production index and crude oil barrel price variables were selected as exogenous factors. The variables that constitute the focus of the study are tested for three different models with the least squares method and Bayesian moving averages method. Upon analyzing the findings obtained from the study, several noteworthy observations emerge: In Model 1, the positive and statistically significant effects of the real effective exchange rate, money supply, and TR interest rates (among the endogenous factors) on food inflation are evident. In Model 2, the positive and statistically significant impact of food and beverage commodity prices on food inflation is observed. In Model 3, which attempts to explain the effects of all variables within a single model, it is found that the real effective exchange rate, money supply, TR interest rates, and food and beverage commodity prices exert positive influences on food inflation, while an increase in oil prices has a negative effect. Among the auxiliary variables considered in Model 2 and Model 3, only the US federal funds rate (FED interest rate) emerges as having a positive and statistically significant effect on food inflation. When assessing the efficiency level of variables in explaining Turkey's food inflation, it is found that the most efficient variables are M1 money supply, real effective exchange rate, FED interest rate, and TR interest rates. These findings underscore the multifaceted nature of factors influencing food inflation in Turkey and highlight the importance of considering various endogenous and exogenous variables in analyzing and forecasting inflation dynamics.

The increasing money supply resulting from expansionary monetary policies implemented during the Covid-19 pandemic has played a significant role in exacerbating food inflation, which has become increasingly chronic. Similarly, the rise in import dependency for food has had adverse effects on food prices, particularly in the face of possible exchange rate volatility. Turkey's reliance on foreign sources for energy production further complicates matters, as higher oil prices, which are a critical input cost in agricultural production, would typically lead to upward pressure on food inflation. However, contrary to expectations, the analysis reveals a negative relationship between food inflation and oil prices in Turkey during the period under review.

This unexpected finding can be attributed to several factors, including the lagged pass-through effect of oil prices on inflation and a decline in demand for energy-intensive products in food production. Additionally, Turkey's lack of savings exacerbates sensitivity to domestic and foreign interest rates. Increases in interest rates not only raise future inflation expectations among consumers and producers but also stimulate demand among consumers and encourage higher pricing policies among producers. The study underscores that the surge in food inflation over the past decade is significantly influenced by financial stability and monetary policies. In response, policymakers should consider implementing strategies to bolster domestic production, ensure financial stability, and enhance the productivity of agricultural producers. By doing so, policymakers can promote social welfare and ensure equitable access to food products, thereby mitigating the adverse impacts of chronic food inflation on society.

References

Altıntaş, H. (2016), Petrol Fiyatlarının Gıda Fiyatlarına Asimetrik Etkisi: Türkiye İçin Nardl Modeli Uygulaması, *Journal of Management and Economics Research*, 14(4), pp. 1-24.

Awan, A. G. ve Imran, M. (2015). Factors Affecting food price inflation in Pakistan. *ABC Journal of Advanced Resear*ch, 4, pp. 74-88.

Baek, J., and Koo, W. W. (2010), Analyzing factors affecting US food price inflation, *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, 58(3), 303-320.

Boonman, T. M. (2023), Portfolio capital flows before and after the Global Financial Crisis, *Economic Modelling*, 127(C), 106440.

Durevall, D., Loening, J. L., and Birru, Y. A. (2013), Inflation dynamics and food prices in Ethiopia, *Journal of development economics*, 104, pp. 89-106.

Eştürk, Ö., and Albayrak, N. (2018), Tarım Ürünleri-Gıda Fiyat Artışları ve Enflasyon Arasındaki İlişkinin İncelenmesi, *Uluslararası İktisadi ve İdari İncelemeler Dergisi*, pp. 147-158.

Food and Agriculture Organization of the United Nations (FAO), (2024). *World Food Situation*, https://www.fao.org/worldfoodsituation/foodpricesindex/en/. Access date: 08.02.2024

Gökçe, C. (2021), Petrol Fiyatı ve Döviz Kurunun Gıda Fiyatları Üzerine Asimetrik Etkisi: Türkiye Örneği, *Business and Economics Research Journal*, 12(3), pp. 599–611.

Güngör, S., and Erer, D. (2022), Türkiye'deki Gıda Fiyatları ile Petrol Fiyatları Ve Döviz Kuru Arasındaki Doğrusal Olmayan İlişkinin İncelenmesi: Zamanla-Değişen Parametreli VAR Modelleri, *Alanya Akademik Bakış*, 6(2), 2481-2498.

İçen, H., Esenyel İçen, N. M., and Polat, B. (2022), Türkiye'de Gıda Fiyatları, Döviz Kuru ve Petrol Fiyatları Arasındaki Asimetrik Ilişki, *EKOIST Journal of Econometrics and Statistics* (37), pp. 149-169.

Khan, R. E. A., and Gill, A. R. (2007), Impact of supply of money on food and general price Indices: A case of Pakistan, *IUB Journal of Social Sciences and Humanities*, 5(2), pp. 125–143.

Kim, Y. J., and Kwark, N. S. (2023), Changes in Inflation Dynamics in Korea: Global Factor, Country Factor, and Their Propagation, *Bank of Korea WP, 11*.

Kotz, M., Kuik, F., Lis, E., and Nickel, C. (2023). The impact of global warming on inflation: averages, seasonality and extremes. *ECB Working Paper Series*, No:2821

Magnus, J. R., Powell, O., and Prüfer, P. (2010), A comparison of two model averaging techniques with an application to growth empirics, *Journal of econometrics*, 154(2), pp. 139-153.

Nazlioglu, S., and Soytas, U. (2012), Oil price, agricultural commodity prices, and the dollar: A panel cointegration and causality analysis, *Energy Economics*, 34(4), pp. 1098-1104.

Shrestha, D. S., Staab, B. D., and Duffield, J. A. (2019). Biofuel impact on food prices index and land use change. *Biomass and Bioenergy*, 124, pp. 43-53.

Sohag, K., Islam, M. M., Tomas Žiković, I., and Mansour, H. (2023) pp. Food inflation and geopolitical risks: Analyzing European regions amid the Russia-Ukraine war pp. *British Food Journal*, 125(7), pp. 2368-2391.

Şahin Kutlu, Ş. (2021), Türkiye'de Gıda Enflasyonunun Belirleyicileri: Svar Modelinden Kanıtlar. *EKEV Akademi Dergisi* (87), pp. 581-598.

Odongo, M. T., Misati, R. N., Kamau, A. W., and Kisingu, K. N. (2022), Climate Change and Inflation in Eastern and Southern Africa, *Sustainability*, 14(22), pp. 1-18.

OECD (2024), Industrial production (indicator). doi: 10.1787/39121c55-en (Accessed on 21 January 2024)

Orkun Oral, İ., Çakıcı, A., Yıldız, F., and Alayoubi, M. (2023), Determinants of food price in Turkey: A Structural VAR approach. *Cogent Food & Agriculture*, 9(1), pp. 2247169.

Taghizadeh-Hesary, F., Rasoulinezhad, E., and Yoshino, N. (2019), Energy and food security: Linkages through price volatility, *Energy policy*, 128, pp. 796-806.

Utkulu, U., and Ekinci, R. (2016). Uluslararası Petrol ve Gıda Fiyatlarından İç Fiyatlara Asimetrik ve Doğrusal Olmayan Fiyat Geçişkenliği: Türkiye İçin NARDL Modeli Bulguları, *Finans Politik ve Ekonomik Yorumlar* (617), pp. 9-22.

Yang, J., Qiu, H., Huang, J., and Rozelle, S. (2008), Fighting global food price rises in the developing world: the response of China and its effect on domestic and world markets, *Agricultural Economics*, 39, pp. 453-464.

Yardımcı, A. (2019), *Bayesci model ortalaması yöntemi: İstihdam oranı üzerine bir uygulama*. *İstatistikçiler Dergisi:İstatistik ve Aktüerya*, 12(1), pp. 15-31.

Worlbank (2024), Food security update, February 1 2024. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://thedocs.worldbank.org/en/doc/40ebbf38f5a6b68bfc11e5273e1405d4-0090012022/related/Food-Security-Update-XCIX-February-01-24.pdf Acces date: 08.02.2024

Zellner, A. (1986), On assessing prior distributions and Bayesian regression analysis with g-prior distributions, in: Goel, P.K., Zellner, A. (Eds.), *Bayesian Inference and Decision Techniques: Essays in Honor of Bruno de Finetti (Studies in Bayesian Econometrics Statistics)",* Vol. 6, Elsevier Science Ltd, North Holland, pp. 233–243

Annex 1. Descriptive Statistics

Variables	Obs.	Mean	Standart Deviation	Min	Max
$\mathbf{INF_{food}}$	203	466.17	485.49	133.18	2552.51
RER	203	93.12	22.89	47.62	127.71
M1	203	712.6 billion	103 billion	63 billion	4631 billion
$\mathbf{INT_{TR}}$	203	13.17	5.45	5.14	35.87
$\mathbf{P_{oil}}$	203	72.80	22.65	16.70	134.02
$\mathbf{CP_{f\&b}}$	203	111.10	16.08	85.23	162.22
$\mathbf{PROD_{food}}$	203	103.79	22.62	68.26	165.69
$\mathbf{PROD_{beverage}}$	203	103.71	21.63	72.47	159.54
$\mathbf{CR_{f\&b}}$	203	72.01	2.19	61.20	77.80
CLI	203	4.86	3.52	-7.99	20.09
$\mathbf{IPI_{OECD}}$	203	95.78	14.96	66.85	119.57
VIX	203	20.34	8.51	9.51	59.89
FFR	203	1.17	1.62	0.05	5.33

Annex 2. Correlation Results

	RER	**M1**	$\mathbf{INT_{TR}}$	$\mathbf{P_{oil}}$	$\mathbf{CP_{f\&b}}$	$\mathbf{PROD_f}$	$\mathbf{PROD_b}$	$\mathbf{CR_{f\&b}}$	**CLI**	$\mathbf{IPI_{OECD}}$	**VIX**	**FFR**
RER	1											
M1	-0.26	1										
$\mathbf{INT_{TR}}$	-0.27	0.25	1									
$\mathbf{P_{oil}}$	0.12	-0.01	0.22	1								
$\mathbf{CP_{f\&b}}$	0.14	-0.01	0.00	0.52	1							
$\mathbf{PROD_{food}}$	0.02	-0.01	0.02	0.15	0.01	1						
$\mathbf{PROD_{beverage}}$	-0.05	-0.03	0.09	0.09	0.13	0.11	1					
$\mathbf{CR_{f\&b}}$	0.10	0.02	0.07	0.04	-0.01	-0.05	-0.01	1				
CLI	0.12	-0.08	-0.03	0.20	0.24	0.01	0.21	0.08	1			
$\mathbf{IPI_{OECD}}$	0.06	-0.09	0.12	0.22	0.11	0.07	0.36	0.09	0.52	1		
VIX	-0.07	-0.08	0.12	-0.19	-0.19	0.03	0.22	-0.10	0.01	0.13	1	
FFR	0.18	0.11	-0.09	0.17	-0.00	0.01	0.03	0.10	0.15	0.23	-0.09	1

Annex 3. The Breakpoint Unit Root test results

Variables	ADF	*Prob*	ADF	*Prob*
	Level		1st difference	
$\mathbf{INF_{food}}$	-0.349988	>0.01	-5.410764	<0.01
RER	-2.427958	>0.01	-11.33454	<0.01
M1	4.520179	>0.01	-10.72907	<0.01
$\mathbf{INT_{TR}}$	-2.926659	>0.01	-13.93409	<0.01
$\mathbf{P_{oil}}$	-4.248760	>0.01	-10.25082	<0.01
$\mathbf{CP_{f\&b}}$	-4.058805	>0.01	-9.381976	<0.01
$\mathbf{PROD_{food}}$	-1.627039	>0.01	-19.61425	<0.01
$\mathbf{PROD_{beverage}}$	-3.118299	>0.01	-17.25011	<0.01
$\mathbf{CR_{f\&b}}$	-2.970791	>0.01	-6.408297	<0.01
CLI	-4.613713	>0.01	-13.07438	<0.01
$\mathbf{IPI_{OECD}}$	-3.847674	>0.01	-16.01476	<0.01
VIX	-4.506585	>0.01	-8.880633	<0.01
FFR	-4.591118	>0.01	-7.804333	<0.01

Note: Akaike and Schwarz information criterias were used. Max. Lag length is preffered as 14.
[1] Since no structural break was detected in the variable, standard unit root test was used.